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[1] [CT]Innovation in Central Europe

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Abstract

The chapter discusses opportunities, needs and challenges of innovation development of the selected Central European transition countries with the aim to shed some additional light on institutions and policies that affect the level of innovation dynamics and competiveness. The analysis is based on the statistical indicators and systemic approach to describe the current level of innovation capacities and factors for their improvements. The information presented covers three areas: (1) national policies on innovation in the Czech Republic, Croatia, Hungary, Poland and Slovenia; (2) institutional responses and progress achieved by individual universities, research labs, university-based science and innovation centers, accelerators and incubators; and (3) firm-level innovation: products, services, processes, and business models which exemplify the implementation of the new innovation paradigm. Prezi, Ravimed, Rimac Automobili, Invea-tech and GEA cases are presented to show how the new paradigm generated innovation, sophisticated solutions, and ideas which have opened up new markets or solved long-standing business problems.

[A] Innovation and research policies in the Central European transition countries

The research and innovation system in Central Europe (CE) has not been studied in sufficient depth, either on a theoretical or empirical level. Consequently, it has sometimes been surmised that CE is simply lagging behind the rest of Europe in terms of scientific and technological performance (Archibugi and Coco, 2005). Moreover, although CE comprises 13 countries, there is some disagreement as to which ones should be classified as part of it.[2] For the purposes of this chapter we focus on five emerging economies: the three largest transition economies: Hungary, Poland, and the Czech Republic, and two ex-Yugoslavia countries, now also EU members, the republics of Slovenia and Croatia, whose size, geographic locale, and cultural similarity merit inclusion. Moreover, their economic structure, research level and technical development are comparable. In terms of innovation and SME competitiveness, these countries are home to growing numbers of innovative, born global companies which sucessfully compete on global markets, e.g. Prezi, Ravimed, Rimac car, Invea-tech and GEA. Presently, these countries are among the most promising emergent markets in CE.

Twenty-five years ago, all these countries were only starting their transition from socialist, centrally planned economies to market-style economies and democracy. For decades trapped behind the Iron Curtain, in the embrace of the Soviet Union (except Croatia and Slovenia), these countries were not very familiar with Schumpeter's concept of innovation as a process of creative destruction initiated by an entrepreneur and with innovation as an essential driver of the "capitalist machine" and economic growth in general. Nor did they have any concept of the national system of innovation (Lundvall, 1992) and its purpose. However, after the major sociopolitical and economic changes of 1990, Hungary, Poland, the Czech Republic, Slovenia, and Croatia made tremendous progress in establishing national innovation systems and policies to foster innovation and catch up with developed European countries not only in concepts and policies but also in competitiveness and growth (Bečić and Dabić, 2012). They turned out to be quick learners under the pressure of tremendous socioeconomic changes that accompanied their transition to a market economy and political freedom.

The most competitive countries in terms of ease of doing businesss and business enviroment are Slovenia and Poland, which topped the global rankings of the Global Entrepreneurship and Development Index (GEDI) in which Slovenia took 24th place and Poland 27th out of 121 countries. As regards the Doing Business Index, Slovenia is ranked 33rd and Poland 45th out of 189 countries. They are followed by the Czech Republic and Hungary, while Croatia is facing more difficulties in creating a stimulating business environment and appropriate institutions to foster business competitiveness.

As regards economic freedom, the Czech Republic is the highest ranked country with a score of 72.2 in 2014. Second place is shared by Hungary and Poland with a score of 67. Slovenia takes fourth place with a score of 62.7 while Croatia is last with an index score of 60.4.
According to the Globalization Index 2014, Hungary is the ninth most globalized country in the world. Other analyzed CE countries are ranked among the top 33 in the annual Globalization Index (out of 192 listed countries in 2014).

The trends of data in other composite indices (the Global Innovation Index (GII), the Networked Readiness Index (NRI) and the Global Enabling Trade Index (ETI)) also clearly indicate that the five selected countries in CE need improvements in terms of competitiveness, innovation, and technology development. The countries' competitiveness would be enhanced by improvements in their performance-related technological readiness and innovation ecosystems. The 2013 data show that the business demography[3] of the CE selected countries consisted of some 3.27 million active enterprises (16 percent of EU-27) with 15.76 million people employed (12 percent of EU-27).

Enterprise births are often thought to be a key determinant of job creation and economic growth, as newly emerging competition stimulates a country's enterprise population to become more efficient and competitive. On the EU level, enterprise birth and death rates average about 10 percent of the total number of enterprises. Compared to EU aggregate values, the Czech Republic, Poland, and Slovenia recorded higher enterprise birth rates.

According to the type of activity start-ups focus on, Poland is the most production-oriented economy in Europe with 41 percent of start-ups and early-stage enterprises in production industries. It is followed by Slovenia and Hungary, while Croatia has the smallest share of start-up companies in the production sector (18 percent). A decline in the share of enterprises operating in production industries (from 47 percent in 2011 to 41 percent in 2012) characterizes all the countries, chiefly in favor of extraction industries and B2C services.[4]

The share of start-ups in B2B services, however, is considered the true indicator of advanced economic development. It is the highest in Slovenia (42 percent) and the figures for Croatia and Hungary follow.[5]

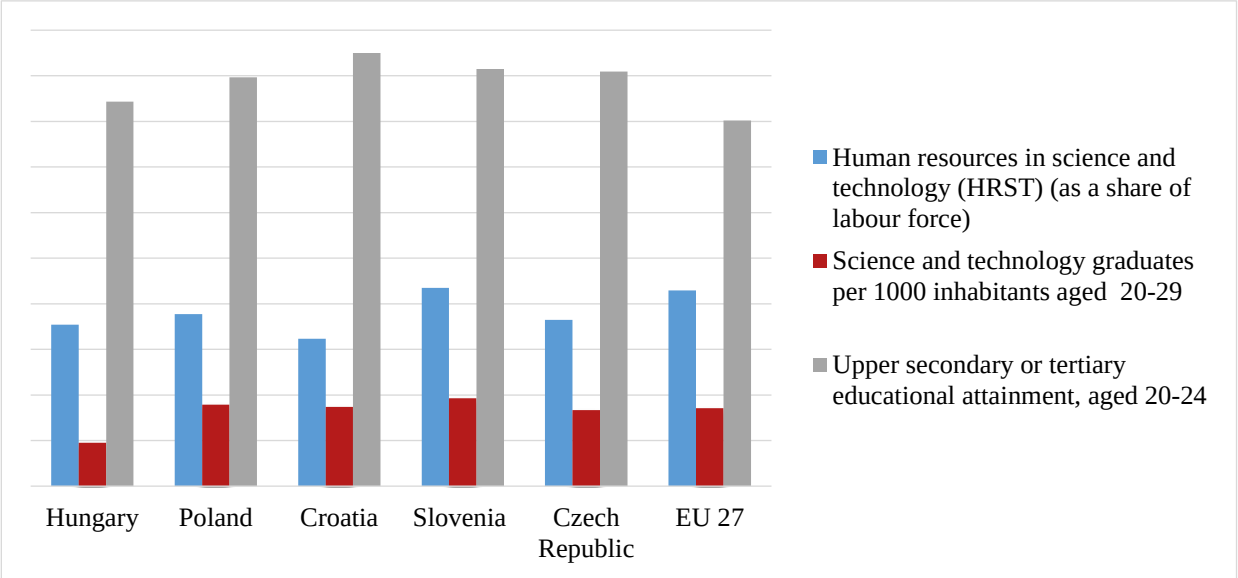
[A] The role of national innovation policy in stimulating innovation and economic development

The innovation policies and systems in the CE countries have mostly been shaped by the theoretical framework of the national/regional innovation systems which highlights various innovation actors and the interactions between them at the regional and national levels (Lundvall, 1992). The emerging CE economies embraced the idea that the competitiveness of a nation does not depend so much on the scale of research and other resources but rather on the way the available resources are managed, organized, and governed, both at the enterprise and at the national level. The idea of building up the institutional setup of private and public institutions that would by mutual interaction foster and accelerate the creation and broad commercialization of innovation was rather attractive to policy makers all over the world, and especially so to policy makers in economies which were trying to make a transition from a socialist planned economy to innovation-driven economies in an increasingly globalized world.

The first phase of transition was devastating for all these economies. It was characterized by a huge decline in economic growth, largely as a result of socioeconomic and institutional uncertainty, disrupted production, and the loss of traditional markets. Innovation and technological development were threatened by the sudden transition to a liberal economy and the privatization of companies which were the pillars of technological development as the most applicative and developmental research was carried out at their in-house institutes (Švarc, 2011). As a rule, the governments abruptly withdrew financial support to the majority of industrial (now private) institutes. The process, known as "shock without therapy" (Radošević, 1996), led to the collapse of the majority of industrial institutes since they were unable to find new markets for their research activities. State-owned companies still play a significant role in the economies of these countries, especially the large companies in the sector of energy and resources. For example, four state-controlled Polish firms are listed among ten largest CE companies in the energy and resources sector in terms of sales revenues (Deloitte, 2013). These are fuel groups PKN Orlen and Lotos (first and fifth respectively), energy group PGE (sixth) and gas giant PGNiG (ninth). Regardless of ownership, there are 166 Polish companies in the CE Top 500 companies as ranked by Deloitte. Poland is followed by the Czech Republic with 87 companies and Hungary with 62 companies among the CE Top 500. Slovenia, represented by 8 companies, is sixth among the 15 countries analyzed, while Croatia, represented by 12 companies, shares seventh place with Lithuania. The top three positions in the CE Top 500 are held by a Polish (PKN Orlen – energy), a Czech (Škoda Auto – automotive), and a Hungarian (MOL – energy) company.

By contrast with the rapid devastation of the long-term technological accumulation in industry, the public research sector was subjected to a more gradual process of reform and remained a substantial basis for education and recruitment of new generations of researchers and human resources. Human resources in science and technology (HRST) in these countries are nowadays close to the EU average, while the number of science and technology graduates surpasses the EU average in Poland, Slovenia, and Croatia (Figure 6.1). The share of young people educated to upper secondary or tertiary level in all the countries is above the EU average (Croatia tops the list of all the member states). All of the above illustrates the human resources potential for future development and growth.

Figure 6.1 Human resources in science and technology
Source: Eurostat (2012)



Apart from their similar socialist historical legacy and pattern of transition process, the national research and innovation systems of the selected countries evolved into rather diverse systems in terms of their size, enterprise composition, research intensity, and structural configuration.

There are great differences among the countries regarding R&D investments: while Slovenia quite surpassed the EU average in R&D investment and stood alongside the most innovative members, for example Sweden and Finland, Poland and Croatia's spending on science was lower than in most other European countries, i.e. only around 13–15 percent of euro per capita spent in Slovenia. The low R&D investments in these countries are conditioned by the low investments of the business sector in R&D. This is due to specialization in more traditional sectors, but also due to the difficulties in access to finance and developing businesses abroad. The weak research capacity of companies in Croatia is also a consequence of the deep and persistent economic crisis that hit Croatia in 2008 and a lack of large companies capable of investing in R&D. The level of investment in R&D fell from above 1 percent in 2004 to 0.75 percent of Croatia's GDP and has stagnated at that level since 2010. Companies in Poland mainly rely on foreign technologies: over 50 percent of R&D investments in Poland cover the purchases of foreign products and services (Erawatch, 2013b).

Underinvestment by the private sector, however, remains the main weakness of the Croatian and Polish research system. It has far-reaching and adverse effects on economic development and growth. The breakdown of total R&D expenditure by source of funds and sector of performance shows reverse shares in Poland and Croatia when compared to the EU average and particularly with Slovenia. In Poland and Croatia the business sector invests about 0.3 percent of GDP and performs about 40–45 percent of all research, which is not sufficient for knowledge-based growth. By contrast, Slovenian companies invest 1.6 percent of GDP and perform almost 76 percent of all research activities (Figure 6.2). This proves that R&D is a priority for the development of medium-high and high-tech competitive enterprises in Slovenia. As a result Slovenia had the sixth highest R&D intensity in the EU.

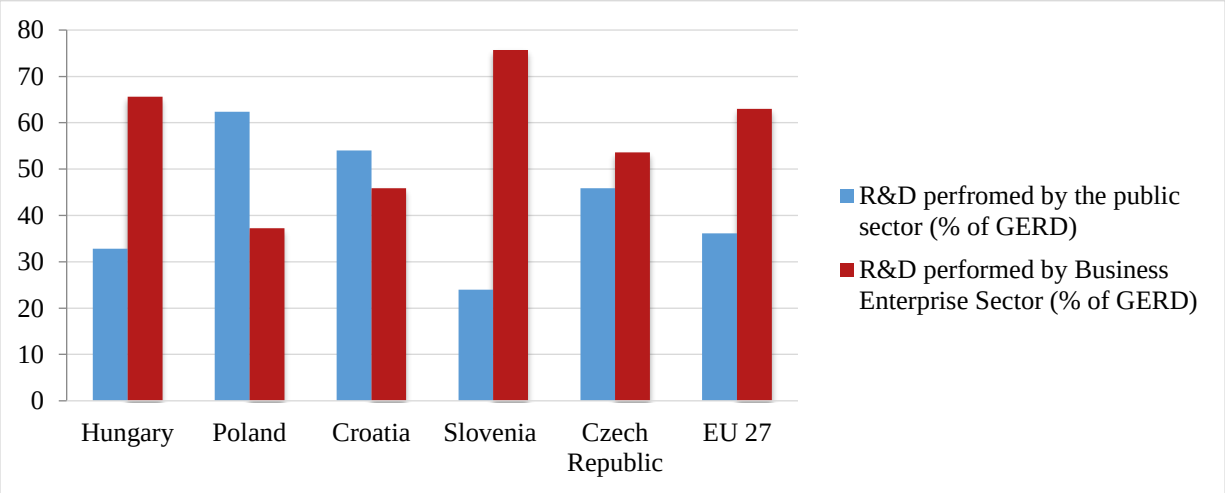


Figure 6.2 R&D performed by public and business sectors, 2012
Source: Eurostat (2012)

The Polish economy, the seventh largest in the EU-28, has undergone a structural change to achieve higher knowledge intensity (a 28 percent improvement since 2000) and Poland's global competitiveness has been improving at a higher rate than the EU average. Polish exports have been growing and Poland has increased its share of high-tech exports by 2 percent annually over the period 2000–10. It is likely that this development reflects the positive effects of substantial foreign direct investment inflows and the

related imports of advanced investment goods that upgraded domestic production structures (European Commission, 2013).

European policy had an increasingly important influence on national innovation and research policies, the dynamics of innovation and technological development, and overall progress of the emerging CE countries. Unlike the countries that became EU members during the fifth round of EU enlargement in 2004, Croatia became a member state almost a decade later, in 2013.
Central Europe has undergone the process of extensive modernization of research and innovation systems through the process of Europeanization. Their research and innovation systems are thus largely determined by the common European strategy of research and innovation which fosters a transition to a knowledge economy to overcome stagnant economic growth.

The progress of achieving common goals in research and innovation policies are regularly monitored (usually once a year) through different analyses and assessments. The Innovation Union Scoreboard (IUS) is a tool which is meant to help monitor the implementation of the Europe 2020 Innovation Union flagship, and provides a comparative assessment of the innovation performance of the member states.
Based on their average innovation performance the member states are classified into four performance groups ("innovation leaders," "innovation followers," "moderate innovators," and "modest innovators." By the IUS 2014 (European Commission, 2014b) all analyzed emerging CE economies belong to the "moderate innovators" group in which innovation performance is below the EU average, except Slovenia which is an "innovation follower," which means that its aggregate innovation performance is above or close to the EU average. The relative strengths of Slovenia are in human resources and in international scientific copublications, whereas the main weaknesses relate to intellectual assets and to marketing of innovations. Also, the economic effects of innovation activity in Slovenia are lagging behind its inputs, which suggests that similar performance could have been achieved with fewer resources. The weak efficiency of Slovenia's innovation system is reflected in low labor productivity compared to the EU average. Furthermore, it is worrying that the efficiency of investment in the innovation system has deteriorated since the beginning of the crisis (Bučar and Stare, 2014).

Although the Czech Republic is among the "moderate innovators," in most of the individual indicators it outperforms the reference group of moderate innovators and is catching up with the category "innovation followers," especially in human resources (young people with upper secondary education), firm activities (non-R&D innovation expenditure) and economic effects (contribution of medium and high-tech product exports to the trade balance). The weak areas in which the Czech R&D&I system lags far behind the EU-27 average are concentrated in open, excellent, and attractive research systems (top scientific publications and non-EU doctorate students), finance and support (venture capital), intellectual assets (patents, trademarks, and designs) and in license and patent revenues from abroad.
Similarly to the Czech Republic, Croatia outperforms the EU average in the share of young people with upper secondary education and in non-R&D innovation expenditure, but in all other areas it is below the EU average, most prominently in the R&D expenditure of the business sector (around 55 percent and the total resources for R&D is provided by the government), knowledge-intensive service exports and intellectual assets (patents, trademarks, and designs).

Poland is performing below the average of the EU for most indicators. Its performance is the weakest in terms of business investment in R&D, number of innovative companies, and linkages and entrepreneurship efforts. The Scoreboard, on the other hand, reveals the high quality of Polish human resources and the recent growth in intellectual assets (patents, trademarks, and designs).

License and patent revenues from abroad, international scientific copublications, and fast-growing innovative firms are the relative strengths of Hungary. High growth is observed for Community trademarks, R&D expenditure in the business sector and sales share of new innovations. A large decline

in growth is observed for non-R&D innovation expenditure, in R&D expenditure in the public sector, SMEs innovating in-house, and Community designs.

Another recent common initiative focuses on fostering innovation, employment, and economic growth following the idea of comparative business advantages and specialization in innovation commonly known as the concept of the "smart specialization strategy" (Foray et al., 2009).[6] It gained its political and economic significance in 2011 when it was established by the European Commission's proposal for cohesion policy in 2014–21[7] as a precondition for using the European Structural and Investment Funds (ESI). Since ESI represents a significant financial input for all EU member states, the national/regional research and innovation strategy for smart specialization (S3) has become a first-rank policy issue.
An analysis of EU research and innovation performance (European Commission, 2013) identified some hot spots and specializations in science and technology (Table 6.1). The health sector, energy, food and agriculture, ICT, environment, automobiles, electronic and advanced materials were shown to be the most promising areas of future development in the emerging CE countries.

Table 6.1 Some identified hot spots and specializations in science and technology

	Hot spots in key technologies
Slovenia	Health, food and agriculture, ICT, materials, new production technologies, environment
Croatia	Health care sector; food processing and agrobusiness; energy technology; electronics and advanced materials and digital techniques
Czech Republic	Automobiles, transport, construction, materials, energy and environment
Hungary	Health, environment, automobiles, biotechnology
Poland	Food, agriculture, and fisheries; energy; environment; security; ICT; materials

Source: Europe, research_innovation performance_2013

[A] Facilitating institutions (R&D labs, multinational firm research centers, university-based science and innovation centers)

Overall globalization and rapid advances in new technologies, ICT in particular, have enabled novel forms of competition and access to new markets for innovative products and services. Integration with Europe and globalization in general compelled emerging CE economies to refine their products and services and engage in a nonstop process of adjustment and innovation. Innovation and research infrastructure plays an important role in this process. During the period of transition of the emerging CE countries to a market economy, the development and upgrading of research infrastructures attracted little attention and less financial support. As the countries were undergoing structural changes and budget reseources were limited, research and innovation suffered social and economic marginalization. With the accession of Poland, Hungary, the Czech Republic, and Slovenia to the EU in 2004, these countries were granted access to resources from Structural Funds for the development of large-scale research and innovation infrastructure. Croatia struggled to keep pace using national resources and EU preaccession funds till its accession to the EU in 2013.

The improvements in SMEs' performance in Europe are, from a broad perspective, underpinned by the impressive number of policy measures that have been introduced by the EU and the member states since 2008. These policy developments took place under the umbrella of the Small Business Act (SBA)[8] for Europe. Adopted in 2008, SBA acknowledges the central role of SMEs in the EU economy and establishes a comprehensive SME policy framework. SBA generated a pro-SME policy momentum which

helped to alleviate the effects of the 2008 global crisis that hit numerous EU countries. In 2010–12 alone, a total of nearly 2400 policy measures to support SMEs were implemented in the EU member states, i.e. an average of 800 measures annually, and almost 90 measures per country (European Commission, 2014a).

In Europe, it is necessary to distinguish between research infrastructures and facilities in the domain of science (e.g. university research centers, private laboratories) and infrastructures for supporting business innovation (e.g. innovation centers, technology parks, technology transfer centers). While the former are used by the scientific community to conduct top-level research and achieve technological advances in their respective fields, the latter are mostly specialized institutions for innovative business support to entrepreneurs.

The innovation and business innovation infrastructure was usually developed in coevolution with the regional policy and industrial/enterprise policy conducted by the EU, which are converging on the objective of supporting clusters at the regional level. Clusters lie at the core of regional development in the EU since focus is placed on groups of firms, related economic actors and institutions which derive productive advantages from their shared proximity and connections. In the emerging CE countries innovation infrastructures for small business development and entrepreneurship is therefore closely related to the promotion of cluster-based approaches by linking firms, people, and knowledge at a regional level.

All member states are obliged to establish regional innovation agencies to assist entrepreneurs and innovators "on the spot" with a wide range of activities and services. To this purpose, innovation agencies cooperate with their many partners: research institutions, training organizations, suppliers of innovation finance, etc. Hungary, for example, established a network of seven regional innovation agencies called RIÜNET in 2005 in order to harmonize and coordinate regional development, organize technological innovation networks, and to provide innovation services to SMEs and start-ups. The regional innovation agencies receive minimal government support and their operation is mainly funded from international programs (i.e. EU FP7 and Interreg) (Erawatch, 2013a). The South Moravian region in the Czech Republic represents a national model of regional innovation policy with its dedicated authorities, well-functioning innovation agency, and productive dialogue with the business community. A number of other regions have achieved varying degrees of success in emulating this model, namely the Moravia-Silesia, Liberec, Zlín, and Hradec Králové regions.

Thanks to the comprehensive policy measures for enterprise development, regional development, and clusters, the supportive, quasi-banking financial institutions (e.g. seed capital funds, business angel networks, regional and local loan funds) are becoming increasingly common all over CE. The same policies resulted in intensive development of institutions enabling the introduction of novel products and services (e.g. technology parks, technology incubators, preincubators, academic entrepreneurship incubators, and technology transfer centers), have been undergoing intensive development.

Institutions which operate at the intersection of science and business in order to support innovative business ideas play a key role in determining the success of the economy. They act as a bridge, facilitating communication between the worlds of business and science. The Polish Agency for Enterprise Development is a business research interface institution which supports technology parks, incubators, and transfer centers on multiple levels. Slovenia established a new agency, SPIRIT, and put it in charge of entrepreneurial support and financing of R&D activity in the business sector. Support for business sector R&D is also partially provided through the Slovenian Enterprise Fund, especially as regards bank guarantees for SMEs engaged in R&D projects and technological restructuring, and support for start-ups in an innovation environment. For the purpose of enhancing SME development and promoting investment and innovation, Croatia has established a new agency, HAMAG-BICRO. The National Innovation Office

is the governmental body responsible for research, development, and technological innovation in Hungary. It also coordinates the activities of the regional innovation agencies.
Technology parks are the most common institutions linking research and business spheres. The Nickel Technology Park Poznań is the first and the largest private technology park in Poland. In recognition of its pioneering role in creating a national commercial platform for cooperation between science and business, the *Nowy Przemysł* business magazine awarded it the title of "The One Who Is Changing Polish Industry". The Nickel Technology Park focuses on supporting development of the biotechnology and IT industry. The Nickel BioCentrum, which started operation in 2012, offers a meeting point for Polish and foreign companies and research teams in the biomedical industry.

The Infopark in Budapest is the oldest innovation and technology park in Central and Eastern Europe. It is primarily an innovation center for IT, telecommunication and software development companies. The Infopark houses the head offices of multinationals such as Lufhansa Systems, Hungarian Telekom, and IT-Services Hungary alongside the head offices of young innovative companies. The Infopark also hosts the headquarters of the European Institute for Innovation and Technology (EIT). The Czech Technology Park adjacent to the Brno University of Technology is acknowledged as the premier institution for the development of business and technology in the CE region. Situated next to the Brno University of Technology, the park facilitates access to research staff, facilities and to a skilled graduate workforce. Among other clients, the Czech Technology Park already houses IBM, FEI, Motorola, Vodafone, and Silicon Figure ics offices.

The technology parks in Slovenia (e.g. Technology Park Ljubljana) and Croatia (e.g. Technology Park Zagreb) are smaller in terms of space for rent and less internationalized than the parks in the other countries. They are, however, hubs for the development of local high-tech companies. The Technology Park Ljubljana hosts around 290 companies and more than 1500 professionals. The Technology Park Zagreb assisted in the foundation of around 70 technological start-ups, some of which have grown to become specialized technological leaders in the region (e.g. ALTPRO, railway safety).

In contrast with innovation and business infrastructures which are mainly coordinated by national governments and supported by ESI funds, the development of large research infrastructures is more centralized at the level of the EU, which is mainly due to their pan-European character (shared access by many countries) and significant resources needed for facilities to be established. The European Strategic Forum on Research Infrastructures (ESFRI) established in 2002 constitutes the most important coordination platform for developing pan-European infrastructures. It also aims to enable national governments to harmonize national roadmaps for research facilities development with European ones. ESFRI fulfills its function by means of the ESFRI roadmap both on the European and member state level. The ESFRI roadmap highlighted the importance of research infrastructures in the EU and has, consequently, had a huge impact on national policies for research infrastructures. The last roadmap lists 48 new or significantly upgraded infrastructures to be developed in 2015–20 mainly in the fields of the environment, biology, and energy. A conservative estimate of the total development cost of these projects amounts to nearly €20 billion, and, on average, €2 million will be required annually for their efficient operation (Technopolis, 2014).
Traditionally a leader in NMR technology, Europe is currently facing growing international competition and needs to fully exploit its scientific and technological potential.

[A] Firm-level innovation

Not enough firms from CE are able to use the European single market as a springboard to the global economy and thus they fail to provide growth and jobs back home in Europe. Compared to the 1980s, CE counts more small companies and fewer big ones. Today's entrepreneurs are different from those of the past. They start their companies with fewer people, focus on freelancers, and hire on a project basis.

Insufficient numbers of CE SMEs grow fast and enter the global marketplace. Among them, only a few become industry leaders, but they can make the growth in 2014 look very different from that a few decades ago. Successful new global start-ups – sometimes dubbed micronationals – could contribute immensely to the economic ecosystem and below we present several cases to support this view. We will use these cases to challenge Emmanuel Carraud's statement: "Europe doesn't believe in its own assets, Europe is not a risk-taker; there are multiple barriers to capital and growth for European entrepreneurs and no culture of failure!"

[B] Prezi

Prezi is a presentation software created by Szabolcs Somlai-Fischer, Péter Halácsy, and Péter Árvai, two Hungarians and a Swede. The start-up was founded in 2009 and the software was developed at Zui Labs, Budapest, Hungary, with the support of Kitchen Budapest and Magyar Telekom. Prezi is a groundbreaking alternative to PowerPoint as it replaces the ordinary slide- based presentations. It is based on the concept of a "zoomable canvas": presentation imagery initially needs to be created on a single canvas. It is then possible to zoom in and out to highlight the various elements of presentation. Prezi makes it easy for the presenter to convey his message clearly and audiences can quickly grasp the structure of the entire story and drill into the details, as necessary.

Arvai was born and raised in Sweden where he was very active on the Stockholm start-up scene, Stockholm being perceived as a pretty advanced start-up city, second only to London and Berlin. Budapest is not usually mentioned in this context but Arvai realized that the amount of talent and creativity Budapest offers is very much on a par with Stockholm. Truth be told, a great many Hungarian companies are achieving global success but we do not necessarily associate them with Hungary. What is more, Hungarians do not think of themselves as a nation of start-ups. This mistaken perception is not likely to cloud the success of Prezi. Commercially oriented markets are charging ahead in adopting Prezi. For example, the Netherlands has a great record in international trade and business and it has been among the first nations to adopt Prezi. In South Korea, which is booming thanks to a very successful import/export industry, Prezi is also very popular. Prezi is, furthermore, listed as a Career-Launching Technology Company on Wealthfront's list of rapidly growing mid-sized private technology companies. Wealthfront is the world's largest and fastest-growing automated investment service with over $1 billion in client assets and a company can only qualify for their career-launching list if it has revenues between $20 and $300 million, and is on a trajectory to grow at a rate in excess of 50 percent over at least the next three years.

Prezi chose to commercialize their product in San Francisco, Silicon Valley, USA. Prezi's founders believed that selling their product on the EU market would require too much effort. They also worried that their business plan would be copied by competitors by the time they got it off the ground in a market like the UK (Koekoek, 2012; Prezi, Wikipedia, 2014).

[B] RAVIMED Ltd, the Republic of Poland

The Polish company RAVIMED Ltd is a medical devices manufacturer located about 25 km north of Warsaw. It produces single-use medical devices, medicinal products, and individual antichemical protection sets. RAVIMED Ltd is the only producer of containers for blood collection, storage, and preparation in Central Eastern Europe. It also provides a range of laboratory services, especially for testing innovative drugs.

Founded in 1991, RAVIMED Ltd first started operating in the Polish market but soon expanded to the former Soviet Union, African and Middle East countries. Presently RAVIMED Ltd employs about 100

staff and its net revenues from sales and equivalent rose by *c*. €780 000 in the period 2011–13. RAVIMED's initial success on the domestic market can be explained by the fact that it introduced a new product on the market (blood bags rather than bottles) and that customers wanted to support Polish companies.

Initially rather simple, RAVIMED's production process for blood bottles was refined through competing with foreign companies which entered the Polish market. In the process, the owners turned down two lucrative takeover offers and chose to develop the company further. The adversities experienced by the company (e.g. the Russian financial crisis) led to product portfolio diversification and contracts for highly specialized products presently produced by only two companies in the world (e.g. autoinjectors used for self-treatment by individuals who were exposed to toxic chemical warfare agents). All technologies employed by RAVIMED were developed in-house and RAVIMED Ltd currently posseses seven patents. RAVIMED Ltd closely collaborates with top research centers in the region and is frequently engaged as a subcontractor in their scientific projects.

An active member of the European Parliament of Enterprises, RAVIMED Ltd is devoted to the constant development and study of advanced products and medical technologies. In 2010 the company established its own R&D department and has since been employing 13 researchers simultaneously running projects of different degrees of complexity. The innovation process relies on constantly monitoring customers' needs, in-house development of potentially valuable ideas, and analysis of competitors' market and R&D activities. This intense innovative activity results in one to two new products and two to three major modifications of existing products which all need to meet high quality and safety standards and get certification. The costly certification process is mostly financed from various EU project funds.

[B] INVEA-TECH, Czech Republic

In 2007, several researchers from Masaryk University got together with others from the Brno University of Technology and CESNET to form INVEA-TECH as a university spin-off. The company was incubated by the South Moravian Innovation Centre (JIC) and still retains strong links with it. INVEA-TECH's headquarters are located in Brno, Czech Republic. It currently has about 35 employees and more than 10 external consultants.
INVEA-TECH manufactures, produces, and sells network monitoring and security solutions based on NetFlow/IPFIX, Network Behavior Analysis (NBA), and FPGA acceleration. Simply put, INVEA-TECH develops and markets comprehensive network solutions internationally. It also provides network solutions to customers like T-Mobile, Siemens, Stanford University, Drogeria market, Konica Minolta, Allianz insurance, Hewlett Packard or Raiffeisen Bank. Their FlowMon system was commended at the CeBIT fair in Hanover twice and in 2013 and 2014 the company was recognized among the Deloitte CE Technology Fast 50 as one of the 50 fastest-growing tech companies in Central and Eastern Europe. Over the past five years they achieved a growth of 326 percent, which earned them 46th place in the recently published Deloitte list. INVEA-TECH is involved in the ACE European acceleration program which helps innovative start-ups and high-growth ICT companies to find partners, clients, and financing to accelerate their move into cross-border and international markets.

INVEA-TECH leads in the flow monitoring and NBA market, which are likely to be the next generation network security trend. Following in the footsteps of AVG, AVAST, and ESET, INVEA-TECH is a good representative of the new generation of cyber security companies.
INVEA-TECH was the first company globally to release new 100GE models of FPGA-based network adapters, thus proving its global dominance in the development of high-speed monitoring probes. Using this technology, clients can monitor and analyze network traffic in the most modern and fastest networks. The company penetrates the global market via security and IT events/fair trades and through channel partner program. Its biggest partners are Orizon (Japan), SecTec (Slovakia), VUMS DataDom, DMS,

Veracomp, Bull, ComSource, ICZ (Czech Republic), Tamkaroo (Germany), Aexux, Vosko (Benelux), Passus, and Clico (Poland).

[B] Tovarna olja GEA, Slovenska Bistrica, the Republic of Slovenia

Tovarna olja GEA from Slovenska Bistrica, a small town in the center of Styria region, Republic of Slovenia, has been producing pumpkin seed oil from roasted and pressed pumpkin seeds since 1904. It presently employs 103 workers and markets its products in more than 20 countries. The main products of the company are vegetable oils, mayonnaise, salads, sauces, fried onion, and feeding stuff components. Company holds the majority share in the domestic market, and besides Balkan markets, the markets in Europe and Asia present a greater and greater challenge. GEA's operations are carried out with emphasis on high-quality and health-friendly products which entirely satisfy the need for vegetable fat and supplementary foods.

From 1904 to 1923 the production process was artisan-like but as the demand for pumpkin oil increased, the company started implementing state-of-the-art industrial solutions for refining, bottling, and increasing production levels. Finally, environmental awareness led the owners to build a new treatment plant. In 2007, GEA introduced the most modern production line for sorting seeds and the production of pumpkin seed oil. In 2010 it started bottling refined oil into PET plastic bottles in the new, entirely continuous, bottling line. Trademark GEA includes 21 different kinds of high-quality and specialized kinds of oil.

GEA is constantly innovating and responding to market changes and final consumers' needs. Each year the company launches several new products and carries out improvements in its operations on the level of production processes and technological equipment, quality control, and purchasing, as well as on the level of sales and environmental protection.

[B] Rimac Automobili, the Republic of Croatia

"Rimac Automobili" is an automobile manufacturing company established in 2009 in Zagreb, Republic of Croatia. Even though it all started in the founder's garage just five years ago, its number of employees tripled in the past year and the company currently employs 60 highly skilled employees. It all started with the founder's dream that he would build an electric supercar, a unique fusion of light build and pure power. Since the required electric systems were not available at the time, the company developed the necessary parts and patented 24 innovations. In order to develop Concept One, their first electric supercar, researchers at Rimac Automobili focused on direct current electric motors and a new propulsion system: "permanent magnet synchronous motor generation." Its unique powertrain is divided into four subsystems (one motor, inverter, and reduction gearbox), each driving one wheel and controlled by the sophisticated engine control unit (ECU). This novel approach to vehicle dynamics is called all wheel torque vectoring (AWTV).

At Rimac Cars, they are especially proud of the fact that all key components are designed, engineered, and produced in-house: the whole Concept One architecture is developed from scratch, around the powertrain and battery pack. The car was first introduced to the public at the 2011 Frankfurt Motor Show and positively reviewed at the 2012 Paris Concours d'Elegance. As at October 2014 altogether eight of these supervehicles had been sold to buyers from all over the world.

Thanks to its highly skilled and creative staff, Rimac Automobili is successfully innovating in other areas as well. For example, the company produced an electric bike, the Greyp G12, which combines the best motorcycles and bicycles. Its top speed is 65 km/h and one can ride for 120 km without pedalling. Finally,

the Greyp G12 t can easily be fully recharged from a standard 220 V outlet in only 80 minutes. It runs on a state-of-the-art battery pack manufactured by Rimac Automobili.

The company raised most of its capital from three big investors who were drawn to Rimac Automobili because they admired the fact that such revolutionary technology had been developed with so few resources. The single largest investor with 10 percent of shares based on a valuation of €70 million is China Dynamics, a company active in the electric vehicle industry in China. The capital which was raised is dedicated to the development and commercialization of future Rimac sportscar models and to improving the company's production capacity.

[A] Conclusions and recommendations

Seven years after the global financial crisis burnt out, the emerging economies of CE are still struggling with the consequences of the economic downturn and trying to reach precrisis levels of economic prosperity. Not only do the countries differ in the rate of recovery but their economic indicators also seem to diverge from those of the majority of old EU member states. Poland and Hungary are forging ahead, with positive growth rates in 2013. They are followed by Slovenia and the Czech Republic, while Croatia is lagging behind due to seven consecutive years of economic recession. The main reason for the sluggish recovery is rooted in the excessive credit boom in Europe before the global financial crisis, and in economic growth mostly based on foreign borrowing instead of innovation-based competition and exports.

Although Poland, the Czech Republic, Hungary, the Republic of Slovenia, and the Republic of Croatia share many socioeconomic and cultural similarities in their historical transition from planned to market economies, their posttransitional development is characterized by a significantly uneven development in terms of economic strength and resilience to the economic crisis. The "shock therapy" economic reforms carried out in these countries in the early 1990s have paved the way to a market economy as a precondition for integration with the EU. However, the speed of transition depended on national specificities and differences which were rooted in various factors such as pace of carrying out structural reforms (e.g. of public administration, pension system, labor market regulations, privatization of banking system), the size of internal markets, ability to absorb EU Structural Funds, share of private versus public sector in the economy, perception of sources of economic growth, etc. The Croatian economy is, for example, oriented towards low-tech/skill services, primarily tourism, as a source of economic growth with a high share of the state in economic life and lack of structural reforms which caused persistent recession. On the other hand, Poland was oriented to industrialization and manufacturing and nurturing an economy dominated by private companies with a reduced share of the state in the economy. There are estimates that the private sector contributes 76 percent of GDP and employs 74 percent of the labor force in Poland, which is quite high for European economies. Poland is among the best performers in the region and the Polish economy has evolved into a significant constituent of the European economy. SMEs are vital to the success of both new and old European economies and are a key focus for innovation support. There are above 20 million SMEs in the European member states, 15 percent of which, or over 3 million, are located in the emerging CE counters.

Of these, 95 percent are really small, employing sometimes just one or two people or family members. With the exception of large companies mainly in the energy, transport, or trade sector, these countries are still lacking the layer of medium to large companies that are the backbone of the old European, and notably German or French, economies.

Despite the huge progress these countries have made in the last 20 years of a market economy, the private-sector companies are still risk averse and lack the ambition to cross national borders and become

true regional companies. Entrepreneurship is hindered by too much bureaucracy, red tape, regulation, and high labor costs which impede growth and innovation. Therefore, changes are needed in both private-sector companies and public policies for fostering innovation and entrepreneurship to respond to global challenges and competition with China, India, Brazil, Korea, etc. which have demonstrated faster growth than Europe or America. The companies should pay special attention to developing management and innovation capabilities to take risky business ideas and develop new business models to respond to the needs of the internationalization of innovation and conducting businesses on a global basis. Introduction of new service models, organizational innovations, and strengthening the knowledge and technology base of companies are crucial factors in success. Closer cooperation with universities and commercializing academic research results may be a valuable innovation-generating channel and an opportunity for growth. The companies in the CE economies receive remarkable backup from EU supporting programs for SMEs, technology, and research. Programs like Horizon 2020 (e.g. collaborative projects, SME instrument, Eurostars) and the European Structural and Investment Funds (ESI) are tailored to foster innovation-based companies and promote socioeconomic development and cohesion among the "old" and "new" states to enable the prosperity of both.

[A] Notes

[A] References

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[1]

[2] Central Europe is sometimes divided into West-Central Europe and East-Central Europe. The countries of West-Central Europe are Germany, Austria, Liechtenstein, Switzerland, and Slovenia. These countries exist on the border of Central Europe and Western Europe, and they can be classified as either. East-Central Europe includes the Slovak Republic, Poland, Hungary, and the Czech Republic. Because these countries exist on the border of Central Europe and Eastern Europe, they are sometimes classified as Eastern Europe instead of Central Europe. Other countries sometimes included in Central Europe are Serbia, Romania, and Croatia. According to the German tradition of geographical delineation, the countries of Northern Europe are classified as part of Central Europe.

[3] Statistical data on business demography in the European Union (EU), treating aspects such as the total number of active enterprises in the business economy, their birth rates, death rates, and the survival rate. In the business demography domain, the business economy covers sections B to N, excluding activities of holding companies – K64.2 (NACE Rev.2).

[4] GEM identifies four categories of economic sectors: extraction, production, business-to-business (B2B) services, and business-to customer (B2C) services.

[5] GEM Poland 2012: 24.

[6] Smart Specialization – the Concept, Policy Briefs No. 5-9, pp. 25–9.

[7] COM(2011) 615, http://www.ipex.eu/IPEXL-WEB/dossier/document/COM20110615.do

[8] http://ec.europa.eu/enterprise/policies/sme/small-business-act/index_en.htm